The Finnish Urban Smart Grid – Challenges and Opportunities

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Net turnover and other operating income 269 M€ (VTT Group 2016)

Unique research and testing infrastructure

Personnel 2,414 (VTT Group 2016)

Wide national and international cooperation network

Energy system transition and Smart Grid R&D&I activities in VTT
We are serving technology and solution suppliers, energy utilities and cities.

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- We have ~450 researchers working with energy related R&D&I.
The Finnish *Urban* Smart Grid – Challenges and Opportunities

Smart grid is a service platform enabling decarbonization of the energy systems, end customer involvement and high security of power supply.

- Finland as a part of the Nordic energy market
- Finnish energy system transition is now promoted by the cities
- Challenges and opportunities in cities
- Ongoing demonstrations in Finland;
  - Urban energy system transition projects
  - Smart Grid projects
- Summary
Finland as a part of the Nordic energy market
Dominance of hydro and nuclear power and minority of weather dependent production

- Hydro power can be utilized effectively to compensate weather dependency of the renewable power production (mostly wind).
- New transmission lines to Europe may change the situation in the future. More flexibility is needed when the share of renewable power production is still increasing ?.
Finland as a part of the Nordic energy market
Electricity by energy source in Finland in 2017 (85.5 TWh)

- Finland is not self sufficient in electricity.
- Hydro power can be utilized effectively to compensate weather dependency of the renewable power production (mostly wind). Share of wind power is not yet very large from energy system point of view.
- Limitations in transmission capacities increase the electricity price in Finland.
Finland as a part of the Nordic energy market
Variation of electricity production and imports in 2017

- Importance of industrial and urban CHP production. Competitiveness is suffering from low price of the electricity.

- Urban energy production (mainly heat) is already shifted toward decentralized solutions. After deregulation of the district heating this tendency will be promoted having effect also on power production. Time schedule for deregulation is open but it will happen in whole EU (?).

- Coal phase out in 2030 (2025).
Finland as a part of the Nordic energy market

Summary

• We have achieved EU goals for renewables (status 40% (2017) / goal 38% (2020)). Decarbonisation of the energy system will continue - government decided to phase out the coal until 2030 (2025).

• Share of wind and solar power are both increasing but are not yet very large from power system point of view.

• Burning of biomass will have increasing importance as well in industry as in cities due to coal phase out in 2030 (2025).

• Dominance of centralized solutions will remain strong in industry.

• Urban energy system transition targeting to carbon neutrality and better vitality of the city is getting stronger. Smart Grids are enablers especially in residential and industrial districts i.e. in micro level.
Finnish energy system transition is now promoted by the cities
Tackling together all urban challenges

http://smartnclean.helsinkibusinesshub.fi/

http://smarttampere.fi/

https://6aika.fi/in-english/
Finnish energy system transition is now promoted by the cities
Tackling together all urban challenges

- Migration to bigger cities or neighboring municipalities is increasing – need for new residential districts is urgent.
- Due to migration need for new jobs is urgent – cities are transforming to innovation platforms to support creation of new businesses (especially for start-ups and SME's).
- Districts should not be planned with business as usual – principle. Carbon neutrality is the main goal - urban energy system transition is needed for it’s implementation.
- Cities start to prefer business creation before maintaining monopolistic energy business environment (energy utilities are mostly owned by the city).
- Energy utilities have to disrupt their own business to accumulate owners needs and future business environments (deregulation of district heating for example) … Before somebody else is doing that.

Goals for urban energy transition i.e. decarbonization are coming from the city council and city management but they do not have energy system and energy business expertise.

- Districts have been implemented "business as usual" inspite of excellent plans. Something must be done and in completely different way than before.
Challenges and opportunities in Finland.
Implementation require joint strategy and ways of working (case Hiedanranta, Tampere)

- **Solutions should be designed for future business environments.** Collaborative management of the risks, development and demonstration solutions for bigger markets have major importance.

- Consideration of alliance model (draft);
  - **Implementation alliances** (Block Alliances). Managing implementation projects based on building and energy specific future regulations (EU, local). Several stakeholders - compromising interests.
  - **Innovation alliance** collecting and managing the development ecosystem. Responsible for implementation project coordination – everything must be implemented according to visions and strategies. Managing of new technology and solutions demonstrations.

- Smart Energy Systems Competence Center (SENECC) established in 2017 to serve different stakeholders in urban energy system transition.
Challenges and opportunities in cities

Energy system transition is a process transition

• Generally spoken **energy system transition is a process transition**, where present processes are changing or disrupted. Completely new processes will also arise, for example, to manage power system flexibility with battery energy storages.

• New technologies and solutions are enablers for new processes, which can be categorized as follows;
  • **Market processes** are implementing legal and regulative responsibilities of the energy market parties.
  • **Business processes** are implementing practical operations of the energy market parties.
  • **Customer service processes** are for implementing customer service operations (e.g. customer invoicing etc.).

• **Present processes in macro level gives guidelines but can not be copied directly micro environment in residential and industrial districts.**
Challenges and opportunities in cities

Opportunities in urban energy transition and smart grids

- Strong willingness of forerunner cities to implement carbon neutrality and urban energy transition.
- Energy utilities start to have interest to urban energy transition due to pressure of the owner. Deregulation of the district heating may change the whole urban energy business environment.
- Coal phase out in Finland until 2030 (2025). Especially Helsinki, Vantaa and Espoo have to modernize their production portfolio.
- Finnish Smart Grid vision (under preparation) and 2nd generation AMR implementations.
- Prosumer orientation in R&D&I projects;
  - End user involvement in energy production (prosumer) and demand response.
  - New technologies (AI, IoT, Block Chains).
- Demonstration projects in Finland;
  1. Urban energy transition projects.
  2. Smart Grid projects.
Challenges and **opportunities** in cities

Finland is forerunner in Smart Metering

- **First large rollouts before regulative actions;**
  - Performance improvements of customer service, fault management and business planning processes.
  - Outsourcing of DSO’s operations (metering, communication, reading etc.).
  - Intelligent part of the DSO’s ICT infrastructure having also capability for remote software updates.

- **Smart metering act in 2009;**
  - Smart meters installed with different mindsets; 1. Performance improvements in DSO’s operations. 2. Just changing the conventional meters to smart meters + modernization of invoicing processes and market processes.
  - Customer sites are now equipped with smart meters.

- **Smart grid development group established 2016 (Ministry of Economic Affairs and Employment);**
  - Smart Grid vision under preparation.
Ongoing demonstrations in Finland
Urban energy system transition projects

http://www.lempaanenergia.fi/content/en/1/20149/About%20the%20project.html
http://valiaikainenhiedanranta.fi/in-english

• Urban energy system transition projects are changing the way of planning, building and operating comprehensive carbon free energy systems for residential or industrial districts (power, heat, cooling, biogas). They are modifying the whole energy value chain including also buildings.

• Districts are completely new and green fields for new market, business and customer service processes. New technologies and solutions are utilized as part of the processes.

• Regulation can not be forgotten but first things first = how to develop and implement carbon neutrality generating also innovation platform for new businesses (mainly start-ups and SME’s). Carbon neutrality and vitality are really in the core.
LEMENE-project (Marjamäki, Lempäälä) (2017 ...).

• First self sufficient industrial micro grid area in Finland (electricity, heating, cooling, gas/biogas).

• Energy system resources;
  • Solar power 4 MWp.
  • Gas engine 8 MWth.
  • Fuel cell solution 116 kWth.
  • Battery energy storage (BES)
  • Biogas solution (under consideration).
  • P2G solution (under consideration).
ECO3 – Smart and ecological

In the ECO3 area we develop bio-, circular and water-economy’s business and innovations on an industrial scale. ECO3 is a nationally significant competence centre, which also runs various demonstrations and pilots.
Hiedanranta (Tampere) (2020 – 2040)

- New residential area for 25,000 people and for 10,000 workplaces.
- Renewal of city district planning practices including infrastructures.
- Boosting piloting of new energy solutions and new businesses:
  - Decarbonization of the self-sufficient energy system.
  - Recirculation economy.
  - Deregulation of the district heating and cooling business.
  - Digitalization of market, business and customer service processes.
  - Buildings based on new standards – building as a flexible part of the energy system.
Ongoing demonstrations in Finland

Smart Grid projects

- Smart Grid projects are developing new technologies and solutions for the present regulative, technology and power system environment. They are integrating active end customers with the power system with renewable power production.

- Focus areas are control of the power distribution networks and interactions between distribution and transmission networks, increase of the power system flexibility by aggregating distributed resources and with battery energy storages (BES), smart control of the buildings, increasing intelligence in energy data processing, smart charging of EV’s and electric buses.

- Research and development of enabling technologies such as AI and block chains are also in the core.

https://en.uuttahelsinki.fi/kalasatama

https://www.smartotaniemi.fi/
Kalasatama (Helsinki) (2012 – 2040)

- New residential area for 25,000 people and for 10,000 workplaces on the waterfront adjacent to the Helsinki inner city (2009 – 2030).
- Test platform and show case for **Smart Grid solutions in Helsinki** including:
  - Local renewable energy sources
  - Electric mobility
  - Battery energy storages
  - Building automation
  - New communication solutions.
- Large ecosystem (Helen, ABB, Fingrid etc.) is developing new solutions.
# Smart Otaniemi (Espoo)

(2018 ...)
The Åland islands
(2018 ...)
Summary

• In Finland we seem to have **two kind of market places** in the future;
  • **Macro market place**, which will remain quite similar than it is today but with new kind of resource portfolio based on renewables (and nuclear power). Security of power supply and flexibility have major importance.
  • **Micro market place**, which is arising in the residential and industrial districts. Deregulation of the district heating will promote decentralization of the energy production. Decarbonization and new business for SME’s have major importance.

• Smart grid is a service platform. **Digitalization** has major importance in planning and implementing new market, business and customer service processes in both market places.

• Different services needed in macro and in micro level – and in rural and urban environments. **Customer need is the driving force for development of new processes**.

• Micro market place is practically a Blue Ocean market place, where the rules of the game are waiting to be set.
A brighter future is created through science-based innovations.